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# **An assessment of the relative contribution of private residential gardens to the city-wide green space benefits and services: the case of Tartu, Estonia.**

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## **Abstract**

There is increasing evidence that urban green space is beneficial to both the urban ecosystem and human health and wellbeing (Bolund and Hunhammar, 1999; de Groot et al., 2002; Valarde et al., 2007; Park et al., 2010). However, most cities inventory and manage public green spaces and ignore private areas. These, such as residential gardens, despite their abundance in many urban areas, are under-researched. Residential gardens are under threat from urban densification and changing socio-cultural, socio-economic and lifestyle conditions (Freeman et al., 2012; Bhatti and Church, 2001). They may constitute a major component of urban green space, increasing urban biodiversity and ecological functioning (Loram et al., 2007; Gaston et al., 2005), which largely depends on their extent, structure and composition (Smith et al., 2005; Loram et al., 2008) as well as the way they link into the wider public green infrastructure. Their morphologies are determined by housing type, neighbourhood pattern and positioning within the urban gradient. Despite constituting a large urban nature reserve, often with significant bird populations for example (Fuller et al., 2008; Cannon et al., 2005) residential gardens are undervalued, but function as a critical space in the urban ecological landscape (Freeman et al., 2012).

## **Key Words**

Green space; residential garden; ecosystem services; urban trees;  
neighbourhood

## **Introduction**

There is increasing evidence that urban green space is beneficial to both the urban ecosystem and human health and wellbeing (Bolund and Hunhammar, 1999; de Groot et al., 2002; Valarde et al., 2007; Park et al., 2010). However, most cities inventory and manage public green spaces and ignore private areas. These, such as residential gardens, despite their abundance in many urban areas, are under-researched. Residential gardens are under threat from urban densification and changing socio-cultural, socio-economic and lifestyle conditions (Freeman et al., 2012; Bhatti and Church, 2001). They may constitute a major component of urban green space, increasing urban biodiversity and ecological functioning (Loram et al., 2007; Gaston et al., 2005), which largely depends on their extent, structure and composition (Smith et al., 2005; Loram et al., 2008) as well as the way they link into the wider public green infrastructure. Their morphologies are determined by housing type, neighbourhood pattern and positioning within the urban gradient. Despite constituting a large urban nature reserve, often with significant bird populations, for example (Fuller et al., 2008; Cannon et al., 2005) residential gardens are undervalued, but function as a critical space in the urban ecological landscape (Freeman et al., 2012).

The main goal of this research was to assess the relative contribution of residential gardens to the city-wide green space ecosystem services and benefits in Tartu, Estonia. In order to achieve this, we aimed to identify the extent to which green space elements, especially trees, found in private gardens contribute to urban green space benefits.

## **Methods**

### *Study Site*

The study was conducted in the city of Tartu, Estonia. The administrative boundaries of the city enclose an area of more than 38.80 Km<sup>2</sup>, with a population of around 100,000. A stratified sample of segments of three typical residential neighbourhoods, Karlova (46 parcels), Tahtvere (31 parcels), and Supilinn (36 Parcels) was surveyed (see Figure 1). In total 15 streets were surveyed from the three different neighbourhoods and data on their garden extent, land cover and tree characteristics were collected and analysed. Figure 2 shows some of the characteristics of the areas.

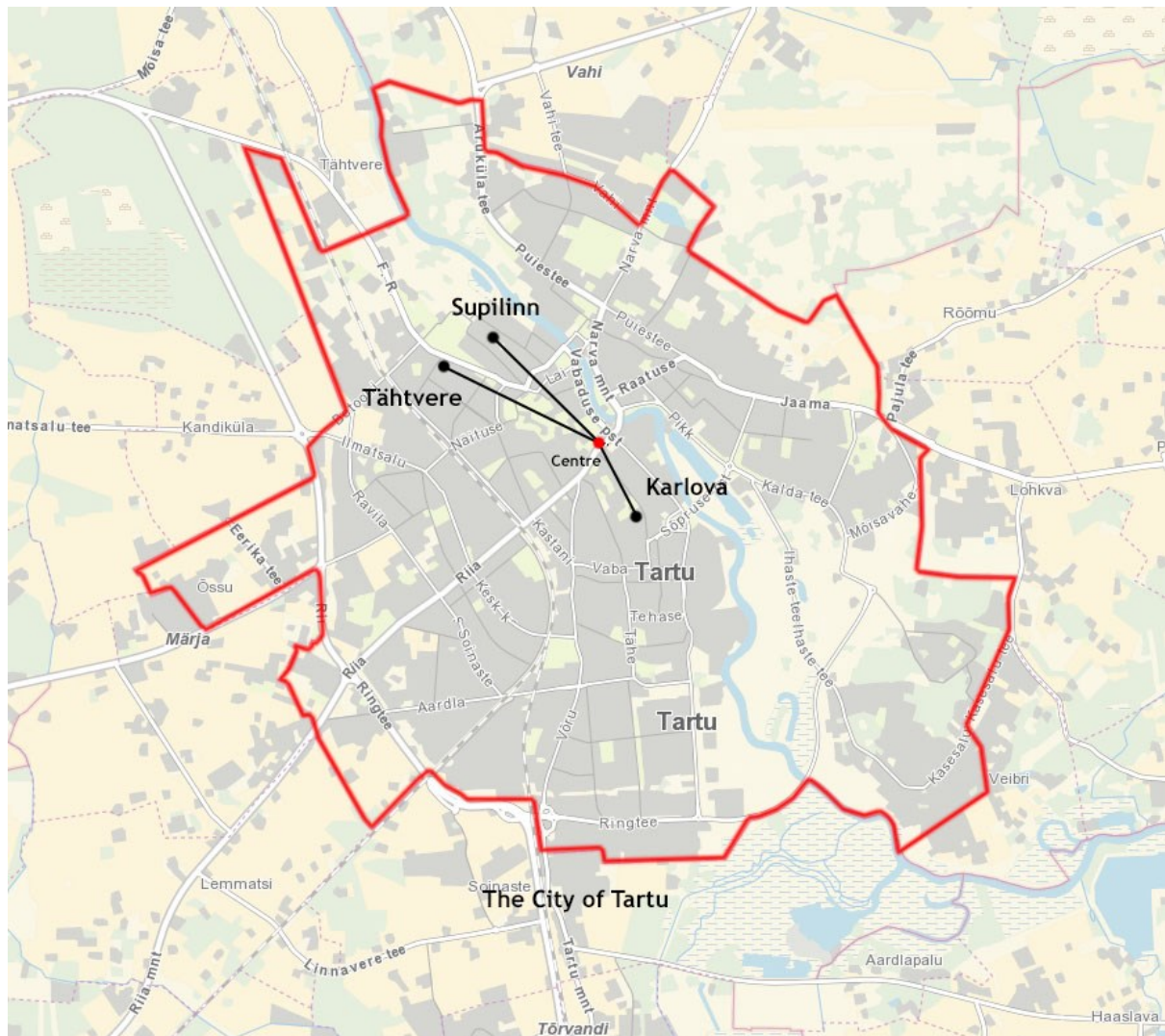


Fig. 1: Location of all three neighbourhoods within Tartu administrative boundary (Source: Maa-Amet Maps, 2016);





**Karlova**



**Supilinn**



**Tahtvere**



**A Rear Garden Space in Karlova**



**Annelinn**



**A corner garden in Karlova**

Fig. 2: Street and garden character of selected neighbourhoods; (Source: the authors)

## **Recording Garden Characteristics**

Parcel size, total garden area, rear and front garden area of the houses were calculated. Tree attributes including tree density; tree types (conifer, deciduous, fruit and non-fruit); canopy cover; diameter at breast height; tree height; tree

maturity and tree species richness were recorded. The information was mapped and a series of statistical analyses of the relationship of the variables was carried out. Figure 3 shows the distribution of the green elements within each sampled segment.



Fig. 3: Sample study areas – maps showing the spatial distribution, green area and tree canopy (drawings not to scale); a) Karlova; b) Tähtvere C) Supilinn (Source: the authors)

## Results and discussion

It was found that there was a significant contribution to urban green made by the large number of trees in the sampled private gardens compared with street trees and other public space elements in the same neighbourhoods. Garden size was had a role in determining garden composition, proportion of green land cover and tree attributes at plot and neighbourhood level: plots with a larger average size, eg in Tähtvere, had more trees on average per plot than in the denser areas of Karlova or Supilinn. Tree density, canopy cover and species richness showed a linear positive relationship with garden size. Conifers were not as common as deciduous trees, but there tended to be more of them on the larger plots. Fruit trees were ubiquitous, but not all gardens possessed them, non-fruit trees being generally more common.

Garden size was found to affect other garden resources such as canopy cover, species richness, tree maturity and presence of other green elements. Large gardens appear to form the main reserve of mature trees (60%) within the sampled neighbourhoods. The garden trees when combined together form connected territories for different terrestrial vertebrate, invertebrate and avian

species, allowing them to move freely, to take refuge and to reproduce. 46.9% of all gardens were also found to have a large proportion of uncultivated or neglected land that can also play a role in ecosystem functioning such as storm water infiltration. At this local scale, comparing them with incidental public green spaces, they were found to be more species-rich, to possess more layers of vegetation and expected to hold a richer biodiversity than urban public green spaces.

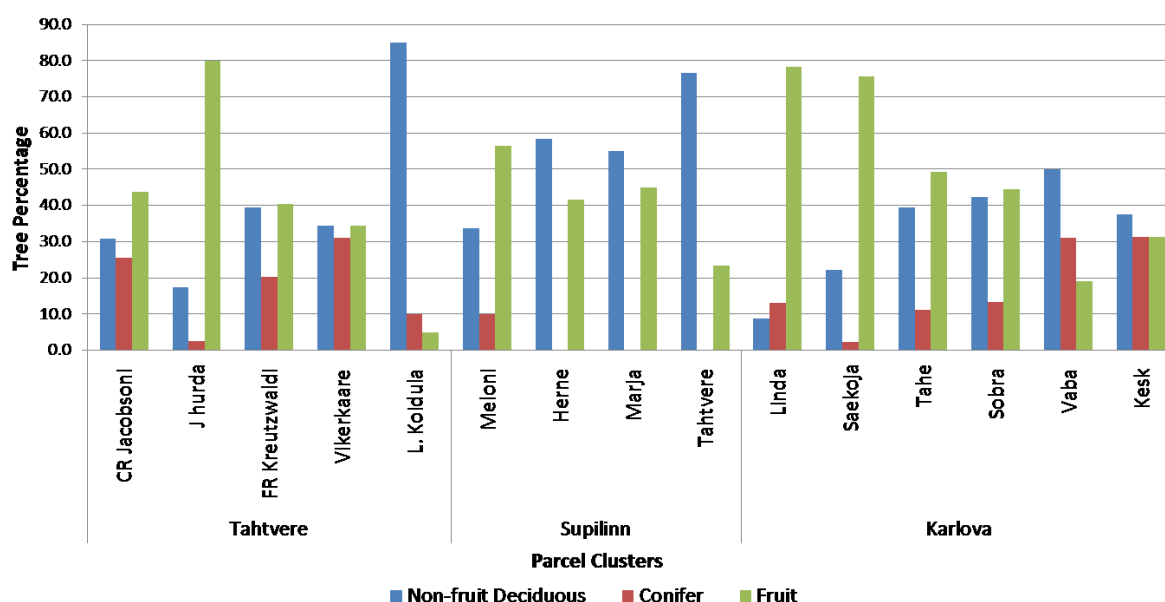


Fig. 4: Percentage distribution of types of trees (conifer, deciduous (non-fruit), and fruit) for all sample clusters, by street;

## Conclusions

The study aimed to see how much private gardens contribute to overall urban green space by surveying the amount, type and quality of green elements, especially trees, in a sample of private gardens in typical residential areas in Tartu. While Tartu is considered to be quite a green city with many public parks, nevertheless, private gardens play host to a large number of trees. In the sampled private gardens it was found that up to 60% of the total tree population was old. These trees do not appear on any official inventory and do not come under the jurisdiction of the city except where people want to remove them. While Tartu is not an especially densifying city, there are trends to build additional houses in larger gardens and the losses of trees through neglect cannot be ignored, especially when the mature trees tend to be found in gardens. Much greater concern and awareness of the role of private green elements is needed by city authorities and they should be included in inventories.

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